TCT-281

The Association Between Cholesterol Crystal And Features Of Plaque Vulnerability On Optical Coherence Tomography

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Background: Cholesterol crystals are often seen abundantly within atheromatous plaques and at sites of plaque disruption. Recent studies have demonstrated that crystallization of cholesterol promotes volume expansion potentially, triggering plaque rupture. However, the relationship between cholesterol crystals and other features of plaque vulnerability has not been characterized. As optical coherence tomography (OCT) enables the visualization of cholesterol crystals in vivo, we investigated the impact of cholesterol crystals on plaque vulnerability by using OCT.
Methods: 102 patients with angiographic coronary artery disease underwent OCT imaging of non-culprit lipid plaque. Cholesterol crystals were identified as a thin, linear region with high signal intensity and backscattering. Patients with (n=44) and without (n=58) cholesterol crystals were compared with regard to clinical characteristics and OCT-derived features of plaque vulnerability.
Results: 43% of study population demonstrated cholesterol crystals in non-culprit atherosclerotic plaque. Patients with cholesterol crystals were more likely to have a history of myocardial infarction (41% vs. 22%, p=0.04) and demonstrated higher leukocyte counts (9362 /ul vs. 7911 /ul, p=0.03). These patients more frequently received ACE-I (64% vs. 38%, p=0.009) and were less likely to be treated with a statin (52% vs. 32%, p=0.04). OCT demonstrated that patients with cholesterol crystals had a thinner fibrous cap thickness and were more likely to contain plaque microchannels and lipid pools (Table).
Conclusions: The presence of cholesterol crystals is associated with features of plaque vulnerability on OCT. These patients require more intensive risk factor modification for the prevention of future ischemic events.

Table.

	Cholesterol crystal (-) (n=58)	Cholesterol crystal (+) (n=44)	p-value
myocardial infarction	41%	22%	0.04
ACE-I	38%	64%	0.01
Statins	52%	32%	0.04
Leukocyte /ul	7911 ± 2585	9362 ± 4309	0.03
FCT	98.6 ± 62.0 um	71.9 ± 25.8 um	0.03
Microchannel	39%	73%	0.001
Lipid-rich plaque (quadrant ≥ 2)	52%	86%	<0.001
TCFA	41%	58%	0.10

FCT = fibrous cap thickness, TCFA = thin-cap fibroatheroma.

TCT-282

The REMEDEE OCT study: A prospective randomized study of the early vascular healing of a novel Dual Therapy Stent in comparison with an everolimus eluting stent

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Background: The Combo Dual Therapy Stent (OrbusNeich Medical, Ft. Lauderdale, FL, USA) combines low-dose sirolimus delivery from an abluminal biodegradable polymer matrix along with a covalently bound anti-CD34 antibody layer in a combination device designed for control of neointimal proliferation as well as to promote vessel healing by stimulating endothelial repair. Optical coherence tomography (OCT) provides important insight into morphology and mechanisms of vessel healing associated with the implantation of intracoronary stents.
Methods: REMEDEE OCT (NCT01405287) is designed to assess the early vascular healing of the Combo stent as compared to an everolimus eluting stent (EES) in patients with Acute Coronary Syndrome (ACS: STEMI & non-STEMI) requiring treatment of single, de novo native coronary artery lesions. REMEDEE OCT is a prospective, multicenter, randomized study designed to enroll 60 ACS patients, randomized 1:1 to be treated with the Combo stent versus an EES (XIENCE V, Abbott Vascular, Illinois USA or PROMUS, Boston Scientific, Natick, MA, USA). All patients receive OCT and QCA follow-up imaging at 60 days post procedure and clinical follow-up at 30, 60, 180, 360 and 540 days. QCA and OCT was performed at baseline and a subset of patients received IVUS and assessment of circulating EPCs. The primary study endpoint is the OCT assessment of the percentage of uncovered struts per stent at 60 days of the Combo stent compared to its control. Secondary endpoints include OCT assessment of indices of neointimal heterogeneity (optical density analysis), and clustering of uncovered and/or malapposed struts. All OCT, QCA, EPC and IVUS data are measured and assessed by independent Core Laboratories. Secondary clinical endpoints will also be reported.
Results: 60 subjects were consented and randomized in a 1:1 fashion at 6 investigative sites in Europe.
Conclusions: The Combo Dual Therapy Stent is a new technology unique in its combined mechanism of action. The REMEDEE OCT 60-day stent strut healing results will be the first RCT evaluation of the effectiveness of the Combo Stent to influence vascular healing.

TCT-283

Intimal Hyperplasia and Vascular Remodeling after Everolimus-eluting and Sirolimus-eluting Stent Implantation in Diabetic Patients. The Randomized Diabetes and Drug-Eluting Stent (DiabeDES) IV Intravascular Ultrasound Trial

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Background: Patients with diabetes mellitus have increased risk of in-stent restenosis after coronary stent implantation due to intimal hyperplasia (IH). The aim of this study (substudy of the SORT OUT IV trial), was to use volumetric intravascular ultrasound (IVUS) to evaluate the effects of the everolimus-eluting Xience™/Promus™ stent (EES) and the sirolimus-eluting Cypher™ stent (SES) on intima hyperplasia in diabetic patients.
Methods: In the DiabeDES IV IVUS trial, serial IVUS 10-month follow-up data were available in 88 patients, including 48 EES and 40 SES treated patients. IVUS of the stented segment and 5-mm long segments immediately proximal and distal to the stent was performed after the procedure and at follow-up. IVUS endpoints included IH volume and in-stent percent volume obstruction.
Results: Baseline clinical characteristics and lesion parameters were similar in the two groups. As compared to the SES group, IH volume was increased in the EES group [median (interquartile range): 2.8 mm^3 (0.0 to 12.6) vs. 0.0 mm^3 (0.0 to 1.1), p=0.001]. In-stent % volume obstruction was increased in EES as compared to SES [median (interquartile range): 1.6% (0.0 – 8.2) vs. 0.0% (0.0 – 1.0), p=0.001]. Peri-stent external elastic membrane (EEM) volume: (post procedure vs. follow-up EES [300 mm^3 (219-491) vs. 307 mm^3 (223-482); p=ns] and SES [316 mm^3 (235-399) vs. 323 mm^3 (246-404); p=ns]) and peri-stent plaque volume: EES [163 mm^3 (103-273) vs. 184 mm^3 (115-291); p=ns] and SES [186 mm^3 (139-248) vs. 175 mm^3 (153-243); p=ns]) were unchanged in both groups. In the distal reference and proximal reference, there were no significant changes in reference-segment EEM, plaque or lumen volume in either of the two stent groups.
Conclusions: In diabetic patients, EES stent implantation was associated with increased IH volume obstruction compared to SES stent without involvement of vascular remodeling.

TCT-284

Significant Correlation Between Coronary And Carotid Atherosclerotic Plaque Components By Intravascular Ultrasound Virtual Histology In Patients With Generalized Atherosclerosis

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Background: Also there are differences in the carotid and coronary vasculature, both vascular distributions are believed to share common pathway in disease progression. However, little is known about atherosclerotic plaque composition and morphological differences between carotid and coronary artery disease. The aim of the study was to determine correlation between intravascular ultrasound virtual histology (IVUS-VH) defined atherosclerotic plaque components in coronary and carotid artery atherosclerotic lesions.
Methods: In a single-center prospective study 100 consecutive patients (60 men and 40 women) with mean age 69.61±8.44 years were enrolled. All patients were scheduled for carotid and/or coronary artery stenting and underwent IVUS-VH examination of coronary and carotid plaque before intervention. Statistical comparison between coronary and carotid artery plaque composition according to IVUS-VH was done with Pearson correlation.
Results: High percentage of necrotic core was found both in coronary (22.55±7.30) and carotid (19.84±9.35) artery plaques, r=0.459, p<0.001. Percentage of dense calcium (13.58±8.15 vs. 7.67±5.64, r=0.557, p<0.001), fibrolipids (12.54±9.08 vs. 19.55±9.96, r=0.379, p<0.001) and fibrotic tissue (51.72±10.33 vs. 53.42±7.95, r=0.422, p<0.001) showed moderate, statistically significant correlation between coronary and carotid arteries, respectively (Figure 1).